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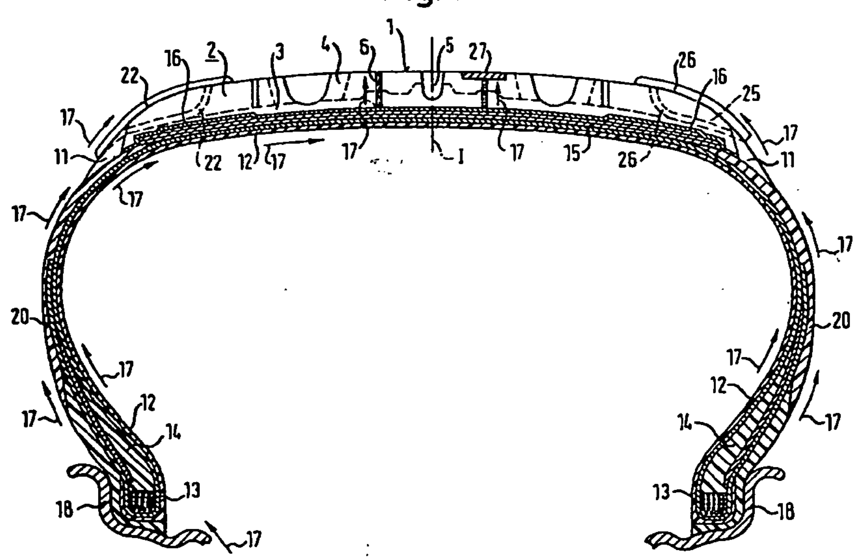
(54) **Vehicle tyre**

(57) A vehicle tyre having a tread strip (2) which provides a ground contacting or tyre running surface (1) made from an electrically insulating or poorly conducting material and having a layer (3) which is a good electrical conductor arranged underneath the tread strip (2), characterised by at least one radially projecting extension (6,11) which is a good electrical conductor extending to the tyre running surface (1) from the layer (3).

Fig. 1



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Description

The present invention relates to a vehicle tyre having a tread strip which forms the tyre running surface and is made from an electrically insulating or poorly conducting material and having, beneath the tread strip, a layer which conducts electricity well and/or another tyre component which conducts electricity well.

In vehicle tyres many criteria must be simultaneously satisfied, in particular wet grip characteristics, behaviour when travelling around curves, fast running characteristics and durability should in each case be ideal. These characteristics in particular are especially good when a rubber mixture is used for the tread strips of vehicle tyres which is commonly called a "silica mixture". This is a rubber mixture with a high proportion of silicic acids.

The disadvantage of such rubber mixtures with a high proportion of silicic acid lies in the fact that these are not electrically conductive or only poorly electrically conductive and the bodywork of a vehicle equipped with such tyres can charge up electrically due to lack of an electrical connection to the road or carriageway. This can go so far that spark discharges occur when, for example, the driver of the motor vehicle wishes to open the filler cap at a filling station. This is naturally extremely dangerous and must be avoided at all cost. A poor or non-existent dissipation of electrical charge from the vehicle bodywork however also has further less dramatic disadvantages. Thus, for example, crackling noises occur in the car radio when driving over expansion joints or bridges or metallic sewer covers. These side effects of silica treads are less desirable.

The invention is thus based on the object of setting forth a pneumatic vehicle tyre of the initially named kind which does not have these disadvantages. In particular an adequate dissipation of electrical charges from the vehicle bodywork to the carriageway should be ensured in order to prevent an electrostatic charging up of the vehicle bodywork.

This object is satisfied in such a tyre, in accordance with the invention, in that the layer of the vehicle tyre which is a good electrical conductor, has radially projecting extension which are good electrical conducts extending up to and into the tyre running surface from the layer.

This design ensures that during rolling of the tyre a component of the tyre which conducts electrically well has a contact t the road or carriageway at least once per tyre revolution. This is sufficient in order to ensure an adequate conduction of electrical charge from the vehicle bodywork to the road and to prevent the bodywork charging up electrostatically. The dissipation thereby takes place via the layer which conducts electricity well and via the tyre sub-construction, which likewise conducts electricity well and which is in connection with the vehicle bodywork via the rim.

Thus, in accordance with the invention, provision is made for the conduction of electricity between the vehicle bodywork and the carriageway which prevents charging up of the vehicle bodywork electrostatically. The tread base layer which consists of a customary rubber mixture which conducts electricity well is preferably considered for the electrically well conducting layer. This tread base layer is preferably so designed that it extends radially outwardly at least regionally through the tread strip and forms a part of the tyre tread. These regions can be kept small since it is sufficient, as mentioned above, when the possibility of an electrical connection between the bodywork and the carriageway is provided one per tyre revolution. The positive characteristics of the tread strip of a silica mixture thereby remain practically unchanged.

The extension of the tread base layer through the tread strip may be achieved during joint moulding, for example injection moulding, of the tread base and of the tread strip, or at a later stage during moulding of the tread pattern. In both the first case and also in the second case the penetration of the tread strip by the tread base is achieved through corresponding moulding of the injection nozzles and in each case the flow processes are taken into account during moulding of the tread pattern. Thus, in both cases, no additional manufacturing step is necessary.

The extensions or parts of the tread base which extend through the tread strip can lie in the finished tyre completely inside raised tread pattern regions or can also lie in transition regions between raised tread pattern regions and in tread pattern recesses. In both cases the electrical contact to the road or carriageway is not impaired by the wear of the tyre but is rather maintained over the entire life of the tyre.

Furthermore, the extensions or parts of the tread base which extend through the tread strip can be provided in the axially central region of the tyre and/or in the shoulder region of the tyre. They can extend along the entire tyre circumference, and thus represent a band which extends in the tread surface, or can be present only section-wise in the circumferential direction of the tyre or can indeed only be present in quasi point-like regions. It is important, as has already been explained, that a part of the tread base enters into contact with the carriageway at least once per tyre revolution.

In order to ensure this the tread strip can also have one or more strips of material which conducts electricity well at the radially outer side which are electrically connected to the tread base. The electrical connection can, for example, take place through retrospective through-contacting of the strips to the tread base. The strips can likewise already have been moulded into the tread strips during the injection moulding thereof.

In a further design of the invention the tyre elements which are normally called wings, and which are arranged in the transition region between the tyre shoulder and the side parts of the tyre, are formed of material which conducts electricity well. At least one of the wings can then extend at least section-wise into the tyre tread and thus form a part of the tyre tread. In this way the wings enable a dissipation of electrical charge from the bodywork to

the carriageway since they are connected at one side to the tyre sub-construction which conducts electricity well.

An extension of a wing can for example be brought about in that at least one of the wings runs out towards the circumferential central plane of the tyre into a thin skin which covers over at least the shoulder region of the tyre. A design of this kind can preferably be achieved by joint injection moulding of the wings and the tread strip through suitable dimensioning of the boundary surface between the wing and the tread strip. Through corresponding moulding of the injection moulding nozzles it is ensured that the wing material is drawn as a thin skin over the tread strip. The wing material so to say floods the tread strip material at the outer side of the tyre during injection moulding.

During subsequent moulding of the tyre profile this thin skin is then pressed into the profile grooves which are thereby formed. In this way this skin of electrically conductive material is also present, in particular, at the side walls of inclined grooves or transverse grooves which open out into the axially outer sides of the tyre. In this manner a permanent electrical connection between running surface and wing is ensured, since even when the tyre pattern wears down the skin of electrically well conducting material always extends along the side walls of the transverse grooves up to the running surface of the tyre.

The parts of the skin which are present at the radially outer sides of the profile blocks are in contrast worn away after only a few kilometres during the rolling of the tyre, so that the underlying tread strip; section of particularly good tread strip material comes to the fore. The thickness of the skin is thus selected to be as thin as possible in these regions. Normally the skin is made wedge-shaped starting from the wing and going towards the mid-circumferential plane of the tyre and has on average for example a thickness in the region of 0.1 to 0.2mm. In the direction of the mid-circumferential plane of the tyre the skin can for example extend somewhat beyond the first circumferential groove, it can however also be made shorter insofar as it only projects into the tyre tread.

A further possibility consists in providing strips of material which conduct electricity well at the outer side of the tyre, with this material, on the one hand, being in contact with at least one wing and, on the other hand, extending into the tread of the tyre. On average the skin can for example have a thickness in the range from 0.1 to 0.2mm. In the direction towards the mid-circumferential plane of the tyre the skin can for example extend somewhat beyond the first circumferential groove, it can however also be made shorter insofar as it only projects into the tyre running surface.

A further possibility consists of providing strips of material which conduct electricity well on the outer side of the tyre, with this material, on the one hand, standing in contact with at least one wing and, on the other hand, extending into the tread of the tyre. These strips can be guided transversely over the entire width of the tyre from wing to wing or, starting from one wing, can only extend a short amount into the tyre tread. In the circumferential direction of the tyre one strip is again adequate for the above-named reasons, although a plurality of strips can be advantageous.

A strip extending over the entire tyre circumference can however also be present which covers over one of the wings and the adjoining region of the tread strip. In this way a good electrical conduction and a uniform rolling of the tyre is ensured. The strip preferably ends shortly above the radially inner edge of the wings pointing to the bead. In this way separating effects or crack formations are avoided.

In accordance with an embodiment of the invention the strips consists of a rubber mixture which conducts electricity well. The strips can preferably be so laid on the tread strip prior to the moulding of the tread pattern that they cover over at least one later-moulded groove section which extends transversely or obliquely to the circumferential direction of the tyre up to one of the wings. In this way technical manufacturing advantages can be achieved on the one hand. On the other hand it is hereby also ensured that the electrical conductivity is also maintained during the wear of the tread pattern since the strip is pressed during the moulding of the tread pattern along the side walls of the inclined or transverse grooves down to and into the base of the groove and the electrical connection between the wing and the tread surface of the tyre thus remains intact. The thickness of a strip of this kind can, for example, amount to 0.25mm and the strip can extend in the transverse direction of the tyre starting from the wing up to the start of the first circumferential groove. This has in particular advantages during a preforming of the circumferential grooves prior to the final moulding of the tyre profile.

In accordance with a further design of the invention a coloured layer of good electrical conductivity is applied at least section-wise to the outer surface of the finished moulded tyre, with the coloured layer covering over at least one groove section extending transversely or obliquely to the circumferential direction of the tyre. The dissipation of electrical charge from the vehicle bodywork via the wings to the road is ensured through this electrically conductive coloured layer. The coloured layer can preferably simultaneously serve as colour coding for the tyre. This has the advantage that, for the manufacture of a tyre of this kind, no additional method step is necessary when compared with conventional tyres.

An embodiment of the invention is shown in the drawing and will be described in the following.

There are shown:

Figure 1 a vehicle tyre in accordance with the invention in cross-section;

Figure 2 a schematic illustration in cross-section of a possible arrangement of the tread base layer and of the tread strip prior to moulding of the tread pattern;

Figure 3 a variant of Figure 2;

Figure 4 the variant of Figure 3 after the moulding of the tread pattern and seen in plan view;
Figure 5 the same variant in cross-section after moulding of the tread pattern;
Figure 6 a plan view of a further variant with a moulded tread pattern;
Figure 7 the variant of Figure 6 in cross-section;
Figure 8 a plan view of a further variant with a moulded tread pattern;
Figure 9 the variant of Figure 8 in Cross-section;
Figures 10a to c the same variant prior to the moulding of the tread pattern;
Figure 11 an illustration of further variants in plane view;
Figure 12 an illustration of these variants in cross-section;
Figure 13 a schematic illustration of another embodiment of the invention in cross-section;
Figure 14 a schematic illustration of a further embodiment of the invention in cross-section; and
Figure 15 a schematic illustration of yet another embodiment of the invention, likewise in cross-section.

Figure 1 shows a pneumatic tyre formed in accordance with the invention. This vehicle tyre is a radial tyre with a tread strip 2 forming a tyre tread 1 beneath which a tread base layer 3 is present. The tread strip 2 and the tread base 3 jointly form the so-called "protector" of the tyre which covers over the sub-structure of the tyre towards the outside.

The sub-structure of the tyre consists of a radially inwardly disposed carcass 12 and two bead rings 13 with bead apexes 14. The ends of the carcass 12 are turned over around the bead rings 13 and the bead apexes 14 for the anchorage of the carcass. At the two axially outer sides of the tyre the latter is closed off by side parts 20. In the transition region between the side parts 20 and the tread strip 2 the tyre has tyre elements 11 which are termed wings. Moreover, with a radial tyre, a breaker 15, for example of several steel cord breaker plies, and a breaker cover 16, for example in the form of nylon bandages are present between the tread base layer 3 and the carcass 12. The tyre tread 1 is of a profiled shape with raised tread pattern regions 4 and tread pattern recesses 5. Arrows 17 in Figure 1 finally schematically represent the flow of an electrical charge from the bodywork, which is here only represented by the rim section 18, to the tyre tread 1.

In Figure 2 it is schematically illustrated how the tread base layer 3 can extend through the tread strip 2 into the tyre running surface 1. All unimportant details have been omitted from this illustration. The tread pattern has not yet been formed. In the variant of Figure 2 an extension or part 6 of the tread base layer 3 penetrates through the tread strip 2 in the middle tyre region 8 while in the variant illustrated in Figure 3 a part 6 of the tread base layer 3 is led through the tread strip 2 up to the tyre running surface 1 in each of the shoulder regions 9 of the tyre.

Figure 4 and 5 show a variant in which, in the middle region 8 of the tyre, parts 6 of the tread base layer 3 are led through the tread strip 2 at two positions. As one recognises from the plan view of Figure 4 these parts 6 extend over the full circumference of the tyre. Both parts 6 are thereby located, as one likewise sees, completely within raised tread pattern regions 4.

In the variant of Figures 6 and 7 a part 6 of the tread base layer 3 is again led through the tread strip 2 in the central region of the tyre. In this variant the part 6 of the tread base layer is however arranged in the transition region 7 between raised tread pattern regions 4 and the tread pattern recess 5 disposed at the centre of the tyre. The entire tread pattern recess 5 can thereby be provided, as illustrated, in material of the tread base layer 3. In this variant the part 6 of the tread base layer 3 which is led up to the tyre running surface 1 is interrupted in the circumferential direction of the tyre as can be seen in Figure 6.

In the variant shown in Figures 8 to 10 the tread base layer 3 is led through the tread strip 2 up to the tyre running surface 1 only in quasi point-like regions 10. These point-like regions 10 in turn lie fully within raised tread pattern regions 4. It is however likewise possible to provide them in transition regions 7 between raised tread pattern regions 4 and tread pattern recesses 5.

In Figure 10 it is schematically illustrated how the design of the parts 6 of the tread base layer 3 which extends through the tread strip 2 can take place. Figure 10a shows a cross-section through the tread strip 2, Figure 10b a cross-section through the tread base layer 3 and Figure 10c a plan view of the tread base layer 3, in each case before the moulding of the tread pattern 4,5. Figures 10b and 10c show that relatively minor material accumulations can suffice in order to bring about a penetration of the tread strip 2 up to the tyre running surface 1 in the regions in which a penetration of the tread strip 2 by the tread base layer 3 is to take place. The material accumulations consist in the illustrated example of thickened portions 19 of the tread base layer 3 which are of trapezoidal shape in cross-section. During the moulding of the tread pattern these material collections are intentionally deformed by the flow of material in such a way that they extend through the tread strip 2 up to the tyre running surface 1.

Figures 11 and 12 show further possibilities of the arrangement of the parts 6 of the tread base layer 3 which extend through the tread strip 2. These can accordingly be provided in the central region 8 of the tyre or in the shoulder regions 9 of the tyre, completely within raised tread pattern regions 4 or in transition regions 7 between raised tread pattern regions 4 and tyre recesses 5 and also over the entire tyre circumference or only over parts of the latter. It is always important that a contact is produced between the road and the tread base layer 3 which is also not lost during wearing down of the tread pattern.

Figure 13 shows in schematic illustration another embodiment of the invention in which the wings 11 are extended so far towards the mid-circumferential plane I of the tyre that they form a part of the tyre tread 1. The tread strip is then made correspondingly narrower. The extension of the wings 11 can also take place in different manner, thus these can extend over the entire tyre circumference up to and into the tyre running surface 1 or however only sectionwise.

The extension of the wings 11 into the tyre running surface or tread 1 can however also take plane in the manner shown in Figure 14. In this design a (thin) skin 21 of the material of which the wings 11 consist extends in each case, starting from the wings 11 which are otherwise formed in customary manner, in the direction towards the mid-circumferential plane I of the tyre up to and into the tread surface 1. Such thin skins 21 can in particular be generated during the joint injection moulding of the tread strip 2 and the wings 11, whereby, through suitable dimensioning of the boundary surface 23 between the wing 11 and the tread strip 2, an overlap is achieved which extends into the tyre tread 1. The wing material floods during injection moulding of the tread strip material onto the other side of the tyre and thereby forms a part of the tread 1.

Furthermore, instead of the wings themselves being extended, strips 22 of material which conduct electricity well can be provided which connect wings 11 of a customary design, such as is for example illustrated in Figures 2 and 3, with the tread surface 1.

A design of this kind is illustrated in Figure 15. Here rubber strips 22 which extend in the circumferential direction of the tyre are present in the transition region between the wings 11 and the tread strip 2. The rubber strips 22 extend, on the one hand, to shortly above the radially inner edge of the wings 11 and, on the other hand, extend up to and into the tyre running surface 1 and thus cover over both the wings 11 and also the tread strip 2. The extent in the direction towards the mid-circumferential plane I of the tyre is selected so that at least one later moulded groove section 25 extending transversely or obliquely to the circumferential direction of the tyre up to one of the wings 11 (see Figure 1) is covered over, so that the strip 22 is pressed into this groove section 25 during moulding of the tread pattern and lines the side walls and the base of the groove. In this manner the electrical connection between the tyre running surface 1 and the wings 11 is maintained even when the tread pattern wears away. The sections of the strip 22 present at the outer sides of the raised tread pattern region 4 are in contrast worn away during use of the tyre after a few kilometres so that the tread strips 2 lying beneath them are exposed.

Finally, as shown in Figure 1, a coloured layer 26 of good electrical conductivity can also be applied to the outer side of the tyre and connect the tread surfaced 1 with at least one wing 11.

Another embodiment of the invention which is likewise illustrated in Figure 1 consists of moulding strips 27 of material of good conductivity into the tread strip 2 which can then in particular be electrically connected with the tread base layer 3.

As one can see with reference to the drawing it is always ensured in all the illustrated embodiments that the tread base layer 3 enters into contact at least once per tyre revolution with the road via the part 6 which is led through the tread strip 2 and which extends up to the tyre running surface 1, or via the wings 11, or via a tyre element 22 or 27 which is connected with a wing 11 or with the tread base layer, or via the coloured layer 26 which is connected to one wing. At this instant an electrical connection then exists between the vehicle bodywork and the road so that electrical charge can flow to the road in the manner illustrated in Figure 1. Electrostatic charging up of the bodywork and the disadvantages which are associated therewith can thus be effectively avoided. At the same time the particularly advantageous characteristics of the silica tread strip are retained, since only minor parts of the tread strip 1 are made of a different rubber mixture. The tyre of the invention thus has the good characteristics of a tyre with silica tread strips, without having its disadvantages.

Claims

1. A vehicle tyre having a tread strip (2) which provides a ground contacting or tyre running surface (1) made from an electrically insulating or poorly conducting material and having a layer (3) which is a good electrical conductor arranged underneath the tread strip (2), characterised by at least one radially projecting extension (6,11) which is a good electrical conductor extending to the tyre running surface (1) from the layer (3).

2. A vehicle tyre in accordance with claim 1, characterised by two or more radially projecting extensions extending from the layer (3) to the tyre running surface.

3. A vehicle tyre in accordance with either of claims 1 or 2, characterised in that the extensions (6,11) are integral with the tread base layer (3).

4. A vehicle tyre in accordance with claim 3, characterised in that the extensions extend in parts (6) radially outwardly through the thickness of the tread strip (2) to form parts of the tyre running surface (1).

5. A vehicle tyre in accordance with claim 4, characterised in that the extensions are formed during joint injection moulding of the tread base layer (3) and of the tread strip (2).

6. A vehicle tyre in accordance with claim 4, characterised in that the extension of the tread base (3) up to the tyre running surface (1) is effected during the moulding of the tread pattern (4,5).

7. A vehicle tyre in accordance with one of the claims 4 to 6, characterised in that the parts (6) of the tread base layer (3) extending through the tread strip (2) lie completely within raised tread pattern regions (4).

8. A vehicle tyre in accordance with one of the claims 4 to 6, characterised in that the parts (6) of the tread base layer (3) extending through the tread strip (2) are arranged in transition regions (7) between raised tread pattern regions (4) and tread pattern recesses (5).

9. A vehicle tyre in accordance with one of the claims 4 to 8, characterised in that the parts (6) of the tread base layer (3) are positioned in the axially central region of the tyre (8) through the tyre strip (2).

10. A vehicle tyre in accordance with claim 4 or 5, characterised in that the parts (6) of the tread base layer (3) are positioned in the shoulder region (9) of the tread strip (2).

11. A vehicle tyre in accordance with one of the claims 4 to 10, characterised in that parts (6) of the tread base layer (3) project around the entire circumference of the tyre.

12. A vehicle tyre in accordance with one of the claims 4 to 10, characterised in that parts (6 and 11) of the tread base layer (3) are provided at spaced apart intervals around the circumference.

13. A vehicle tyre in accordance with any of claims 1-12, characterised in that the tread strip (5) has one or more strips (27) comprising material which is a good electrical conductor, the strips (22) being electrically connected to the tread base layer (3).

14. A vehicle tyre in accordance with claim 1, characterised in that extensions (11) comprises tread wings.

15. A vehicle tyre in accordance with claim 14, characterised in that at least one of the wings (11) tapers off at least section-wise towards the equatorial plane of the tyre (I) into a thin skin (21) which covers over at least the shoulder region (9) of the tyre.

16. A vehicle tyre in accordance with claim 15, characterised in that the thin skin (21) is produced during injection moulding of the wings (11) and the tread strip (2), and an overlap is provided extending into the tyre running surface (1).

17. A vehicle tyre in accordance with claim 14, characterised in that one or more strips (22) of material of good electrical conductivity are present at the outer side of the tyre which extend at one end into the running surface (1) of the tyre and at the other end stand in contact with at least one wing (11).

18. A vehicle tyre in accordance with claim 17, characterised in that the strips (22) cover over the wings (11) and terminate shortly above the radially inner edge (24) of the wings (11) pointing towards the bead ring (13).

19. A vehicle tyre in accordance with claim 17 or 18, characterised in that the strips (22) are so applied to the tread strip (2) prior to moulding of the tread pattern (4,5) that they cover over at least one later moulded groove section (25) which extends transversely or obliquely to the circumferential direction of the tyre up to one of the wings.

20. A vehicle tyre in accordance with claim 19, characterised in that at least one longitudinal strip (22) extending over the full tyre circumference is present and respectively at least partially covers over one of the wings (11) and the tread strip (2).

21. A vehicle tyre in accordance with claim 14, characterised in that a coloured layer (26) of good electrical conductivity is disposed at least section-wise onto the outer side of the complete tyre, wherein the coloured layer (26) covers over at least one groove section (25) which extends up to one of the wings (11) and is transversely disposed or inclined relative to the circumferential direction of the tyre.

Fig. 1

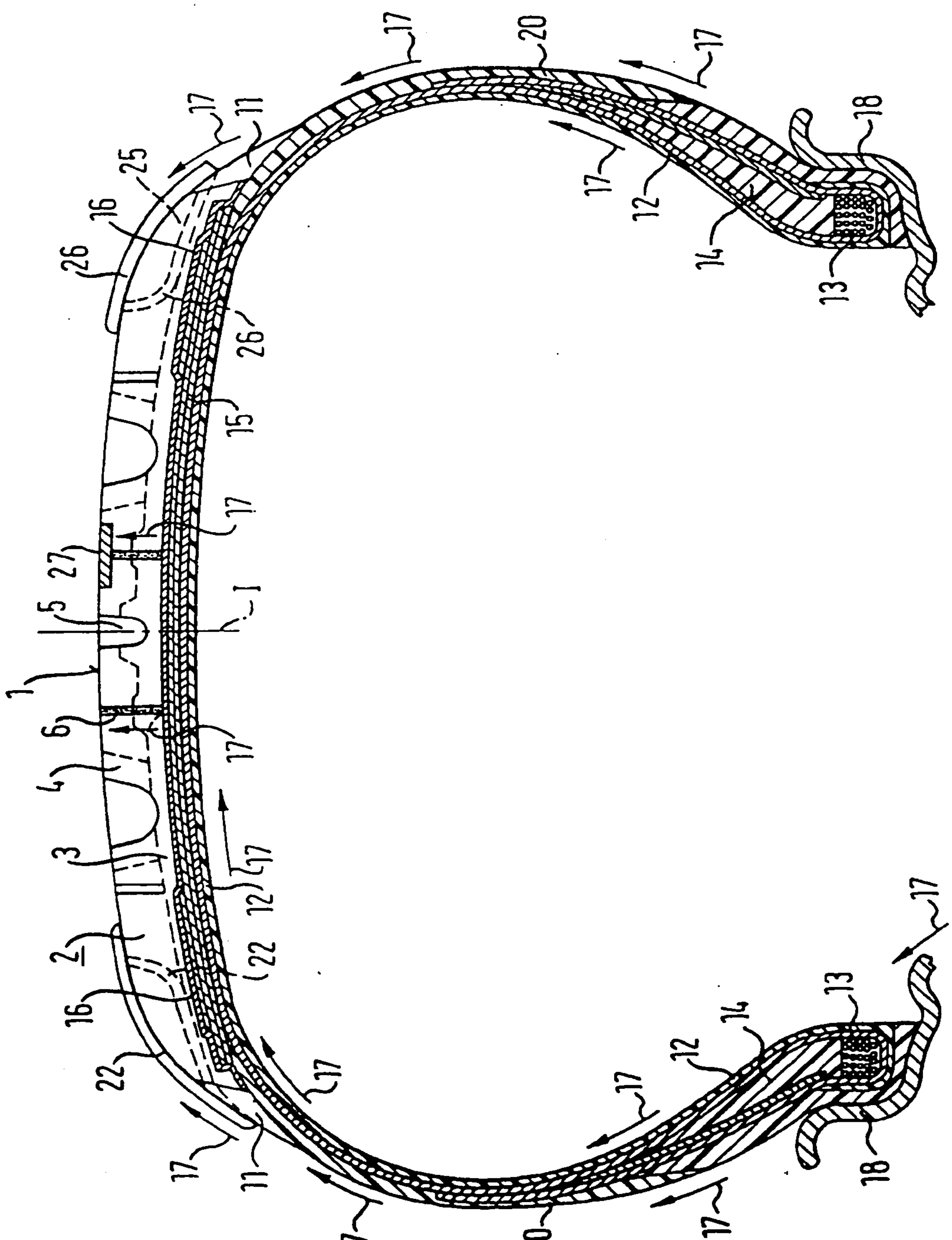


Fig. 2

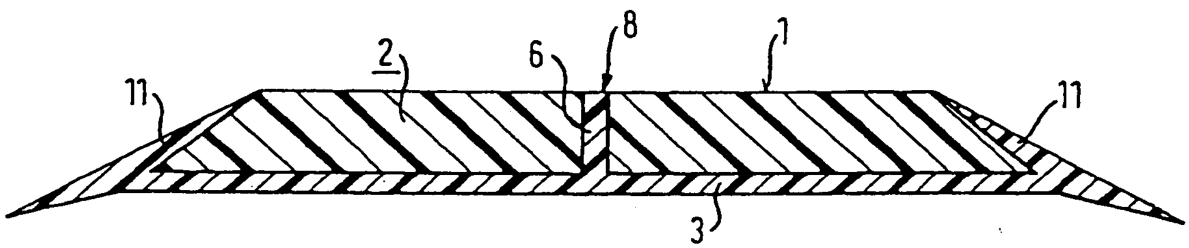


Fig. 3

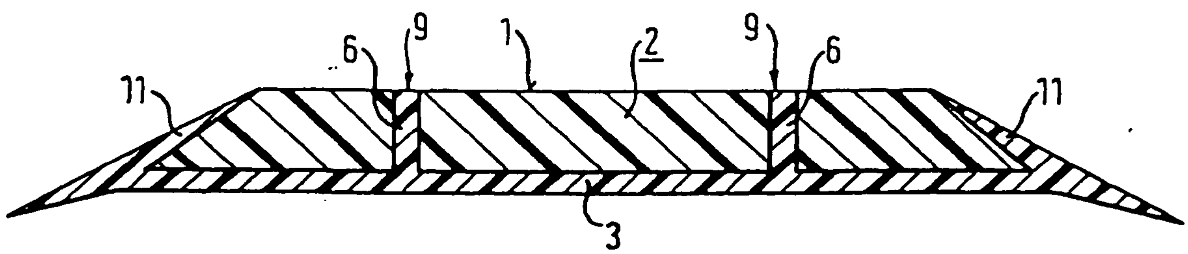


Fig. 4

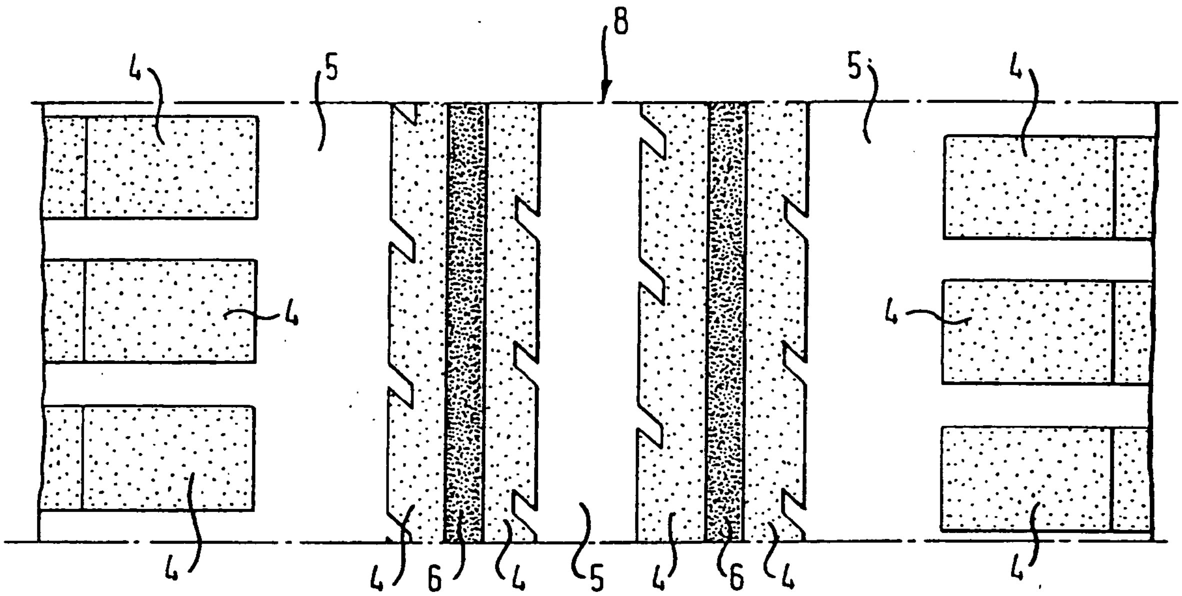


Fig. 5

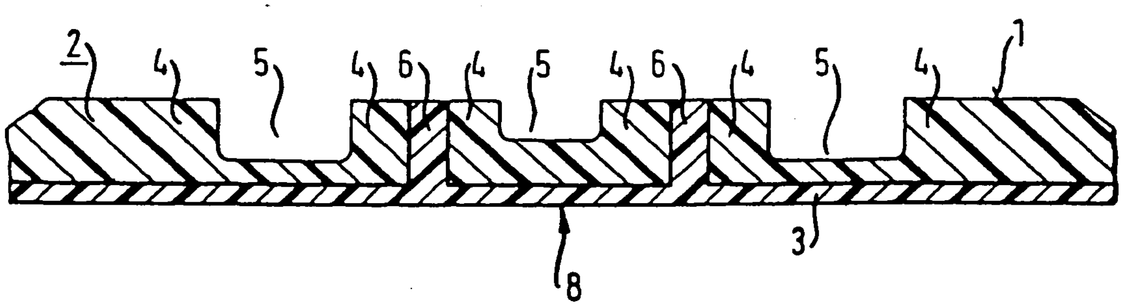


Fig. 6

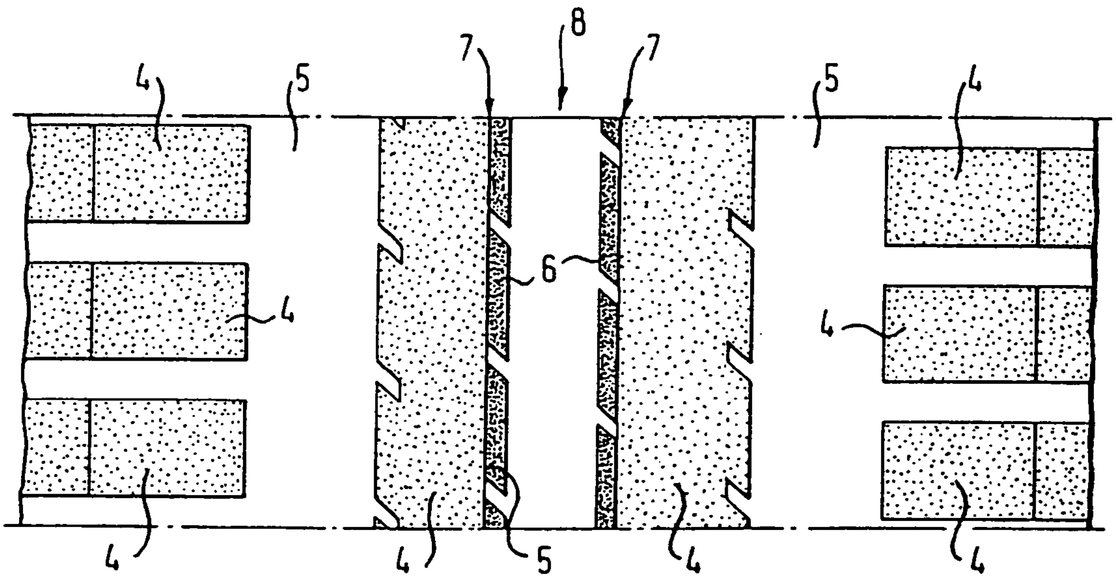


Fig. 7

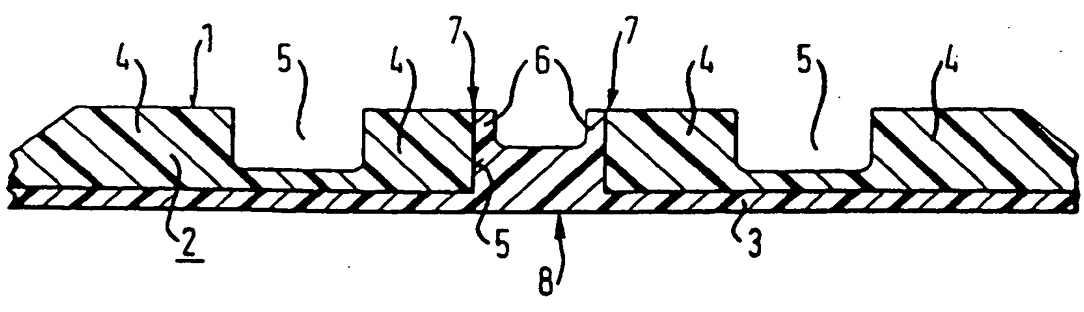


Fig. 8

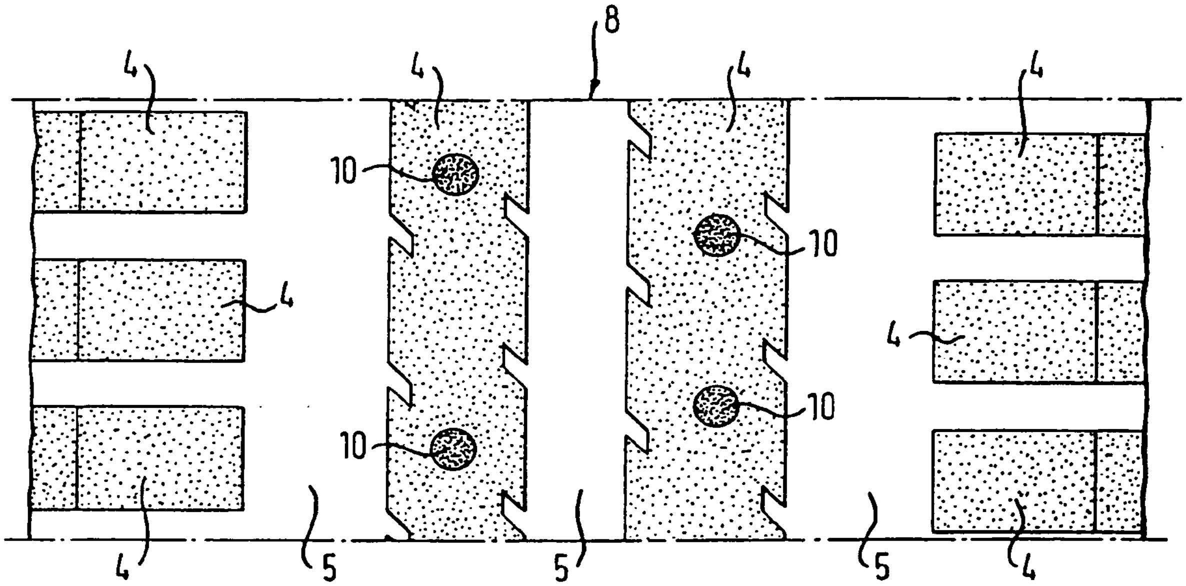


Fig. 9

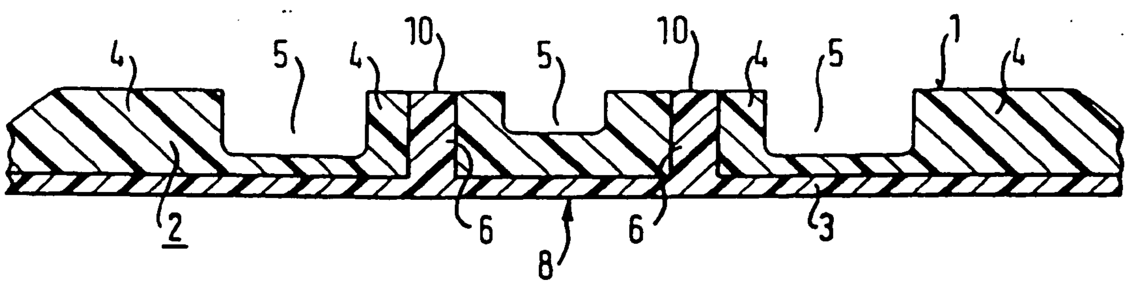
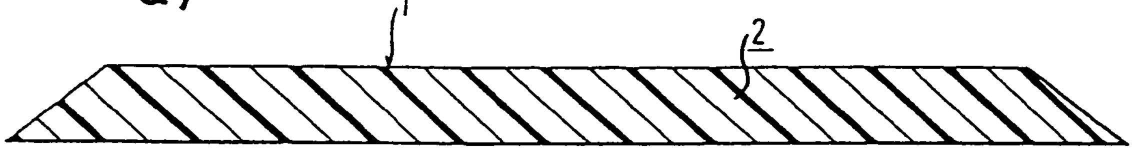
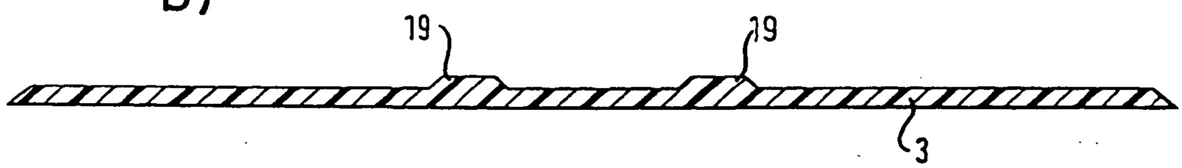


Fig. 10

a)



b)



c)

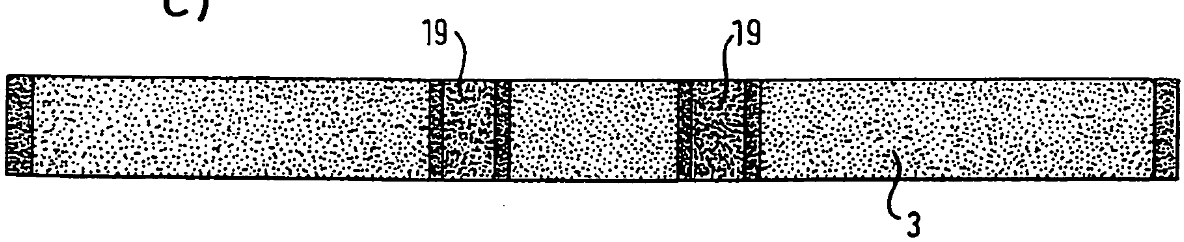


Fig. 11

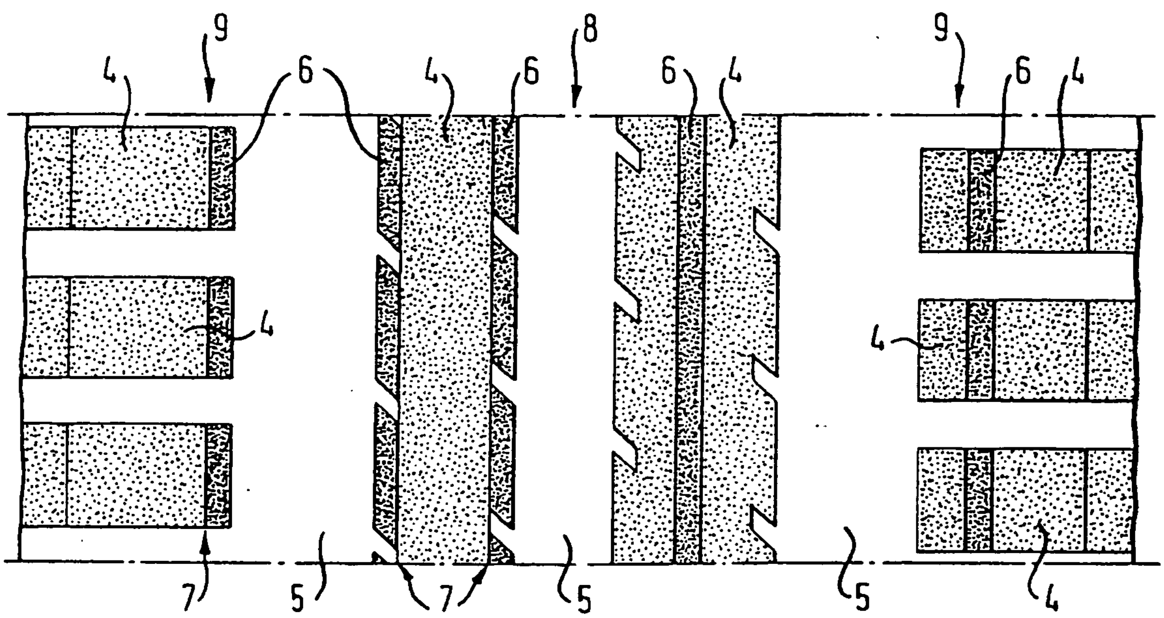


Fig. 12

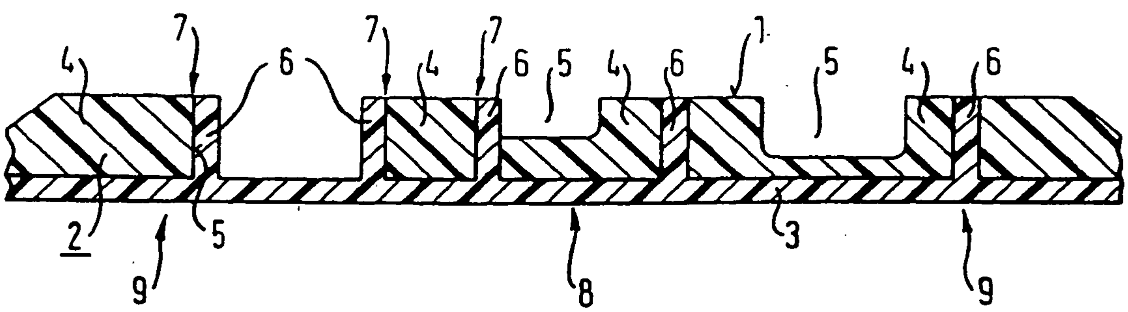


Fig. 13

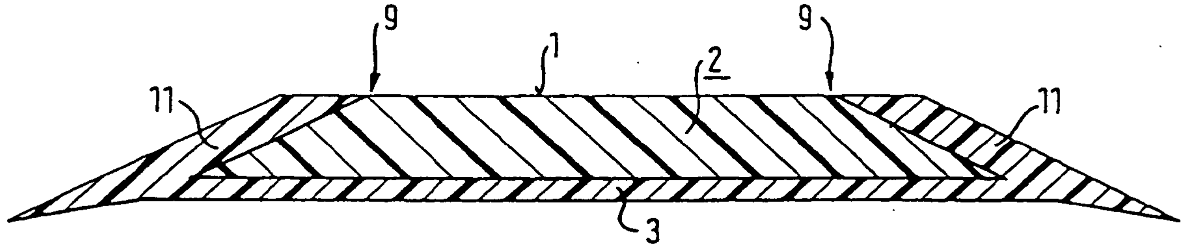


Fig. 14

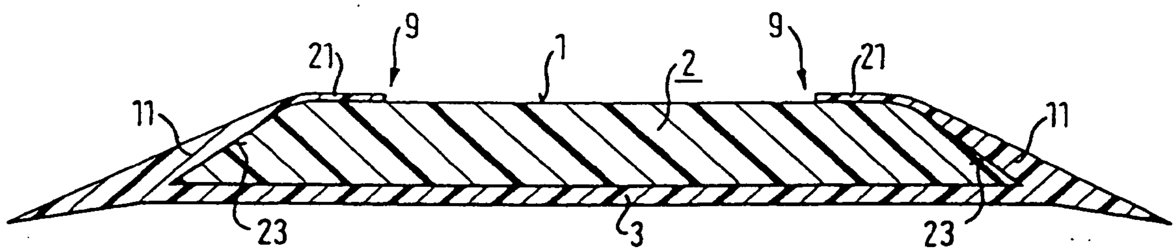
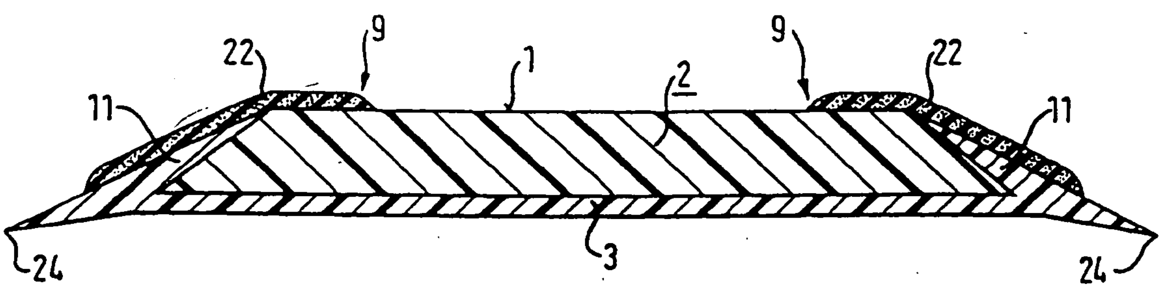


Fig. 15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 9276

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
P,X	EP-A-0 658 452 (PIRELLI) 21 June 1995 * claims; figures * ---	1-4, 9-11,14, 15	B60C19/08 B60C11/18
P,X	EP-A-0 681 931 (SUMITOMO RUBBER IND) 15 November 1995 * claims; figures * ---	1-4, 9-11,14, 15	
X	GB-A-544 757 (THE U.S. RUBBER CO.) * page 4, line 62 - line 81; claims; figures * ---	1,12	
X	GB-A-551 657 (FIRESTONE TIRE&RUBBER CO.) * claims; figures * ---	1	
A	DE-A-42 32 004 (CONTINENTAL AG) 31 March 1994 * claims * ---	21	
A	EP-A-0 106 838 (SEMPERIT AG) 25 April 1984 * claims; figures * -----	1-21	TECHNICAL FIELDS SEARCHED (Int.Cl.6): B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 March 1996	Baradat, J-L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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